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Full length Research Paper

Evaluation of integrated use of seed dressing, dust and foliar chemical insecticides against termite (*Microterme*s spp.) on upland rice at Metema district, North Gondar, Ethiopia

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Abstract

Rice is among the important cereal crops grown in different parts of Ethiopia as food crop. Among different types of rice, upland rice is mostly at risk from soil insect pests, including termites which cause significant yield losses through attacking all portions of the rice plant. The experiment was conducted at Gendewuha Research Station in Metema district since 2011/12 main cropping season to determine the efficacy of integrated use of seed dressing, dust and foliar chemical insecticides against termite. Six treatments such as Apron Star 42 WS seed dressing chemical insecticides, Apron Star 42 WS plus Ethiosulfan 5 % dust insecticide, Apron Star 42 WS plus Diazinon 60% EC foliar insecticides, Ethiosulfan 5 % dust, Diazinon 60% EC and Control were used and arranged by using RCBD with three replications. All data were analyzed by using SAS computer software. Plots sown with seeds treated with Apron Star plus Ethiosulfan (676.67) showed least significant differences as compared with Plots sown with seeds treated with Apron Star plus Diazinon (646.67) and seeds treated with only Apron Star (595.00). Whereas, there were high significant differences (P<0.01) as compared to plots treated with Ethiosulfan (533.33), plots sprayed with Diazinon (515.00) and control (33167) in the case of stand counting at harvesting. Least significant difference was observed between plots sown with seeds treated with Apron Star plus Ethiosulfan (100.13cm), Plots sown with seeds treated with Apron Star plus Diazinon (95.40cm) and plots sown with only Apron Star (87.13cm) on plant height recorded at harvesting. However, high significant differences (P<0.01) observed as compared to Ethiosulfan (81.86cm), Diazinon (77.20cm) and control (66.06cm). No significant difference was observed in Plots sown with seeds treated with Apron Star plus Ethiosulfan as compared to Plots sown with seeds treated with Apron Star plus Diazinon (646.67) and sown with only Apron Star with least mean number of damaged plants of 45, 60 and 71.67per plot respectively. However, significant number of damaged plants due to termite was recorded from plots treated with Ethiosulfan (98.33) and plots sprayed with Diazinon (108.33). The highest number of damaged plants was recorded from control (226.67). There was significant difference between treatments on yield. The highest yield was obtained from Plots sown with seeds treated with Apron Star plus Ethiosulfan (6.20 kg) and Apron Star plus Diazinon (6.01kg) followed by sole Apron Star (4.50kg) and Ethiosulfan (3.00kg). The lower yield was obtained from plots sprayed with Diazinone foliar insecticide (2.03kg) and control (1.08kg). Apron Star seed dressing insecticide plus applying Ethiosulfan dust insecticide at sowing time or one times Diazinon foliar insecticide 15 days after seedlings emerged have shown highest efficacy in controlling termite through reducing the population and damages via increasing yields. Sole application of Apron Star seed dressing insecticide has also showed promising results against termites.

Keywords: Seed Dressing, Dust, Foliar, Termite, Upland Rice

INTRODUCTION

Rice is by far the most economically important food crop in many developing countries, providing two thirds of the calorie intake of more than 3 billion people in Asia, and one third of the calorie intake of nearly 1.5 billion people in Africa and Latin America (FAO, 1995a). It is one of the major food crops in Africa, especially in Western Africa, and is gaining popularity in East and Southern Africa. For instance, rice consumption growth rate in Southern Africa and East Africa was largely higher than in West Africa during the 2001-2005 periods (CGIAR, 2007b).

Rice is among the important cereal crops grown in different parts of Ethiopia as food crop. Currently, rice is considered as the millennium crop believed to contribute in food security "4th food security crop after wheat, maize and the Ethiopia's traditional food crop 'tef'" (Taddesse, 2011). The country has immense potentials for growing the crop. It is reported that the potential rice production area in Ethiopia is estimated to be about 5.4 million hectares. According to National Rice research and document strategy (2009), the trend in the number of rice producing farmers, area allocated and production shows high increase rate especially since 2006. The number of farmers engaged in rice production has increased from about 53 thousand in 2006 to about 260 thousand in 2008. Similarly, the area allocated has increased from about 18 thousand in 2006 to about 90 thousand ha in 2008 along with production increase from about 150 thousand tons in 2006 to about 286 thousand tons in 2008. According to Tareke (2003), four rice ecosystems were identified in Ethiopia. These are: upland rice, rain fed lowland rice (Hydromorphic), irrigated lowland ecosystem, and paddy rice (with or without irrigation). Out of the total national production of rice in 2008, 40% is produced in the Amhara regional state, 1.14% in Tigray region, 0.41% in Benshangul-Gumz, 7.23 % in Oromia, and 1.55 % in Gambella ,13.33% in Somalia, 27.18% Southern region (NRRDS, 2009).

In Africa, the major upland rice insects are stalk borer, Termite, Africa bollworm, Mole cricket and sucking bug (Breniere, 1976). Upland rice is mostly at risk from soil insect pests, including termites which cause significant yield losses through attacking all portions of the rice plant and all stages of plant growth (Agunbiade *et al*., 2009). Termites are an important component of tropical and sub-tropical ecosystems. They are considered to be the most significant soil insect pests of crops in Africa (Wood and Cowie, 1988**)** and attack a wide range of crops at all stages of the growth cycle (Mitchell, 2002). Although, they are problem in upland rice, infestations can also be severe in light-textured low moisture content soils in rain fed wet land areas.

Rice production is affected by a wide range of insects, diseases, weeds, birds and other vertebrate pests. With Rice being a recently introduced crop in Ethiopia, little is known about the types and prevalence of pests damaging the crop. For some of the pests well recognized in significantly affecting the crop, for example, pests like termites and weeds) (Teshome and Dawit, 2011).

Termites attack living rice plants when dead plant material is not available and generally late in the crop growth stage (Pathak and Khan, 1994). They attack drought-stressed crops and prefer older plants having greater cellulose content. They tunnel through the plant stem and eat the roots. The attacked plants become stunted and then wilt. Termite attack also predisposes plants to further damage by ground-dwelling pests such as rodents, ants, saprophytic fungi and bacteria (Wood and Cowie, 1988).

Yield losses due to termite damage ranging from 50 to 100% have been reported by Sekamatte *et al*. (2001) and Rao *et al*. (2000). Broad-spectrum and organochlorine insecticides have been largely relied upon for the control of termites (UNEP, 2000). Recently, the problem of termite is very severe in upland rice growing areas of Metema district and young rice plants are cut off at the ground, covered with soil and eaten. To date, there is no available effort for the management of termite on the upland rice of Metema areas. This experiment was initiated to determine the efficacy of integrated use of seed dressing, dust and foliar chemicals insecticides against termite.

MATERIALS AND METHODS

Site Description

The experiment was conducted in Metema district of Amhara Regional State. It is located about 900 km North West of Addis Ababa and about 180 km west of Gondar town. The district has an international boundary of more than 60 km distance between Ethiopia and Sudan. The site is situated at latitude 12^0 57' N and longitude 36^0 11' E. The total population of the district is 91,216(IPMS, 2005).The altitude of Metema ranges from 550 to 1608 meters above sea level. The topography of the district is almost flat with 2-5% slope and the soil color is black (80%), red (15%) and grey-brown (5%). The maximum and the minimum annual temperature range between 22 and 28 degree Celsius respectively. The daily temperature is high during the months of March to May reaching as high as 43 degree Celsius. The rainy season extend from June to September. The mean annual rainfall of the area ranges from about 850 to 1100 mm (IPMS, 2005). The study location is as shown in "Figure 1".

Experimental Materials and Design

The experiment was conducted at Gendewuha Research Station in Metema district under Gondar Agricultural Research Center since 2011/12 main cropping season.

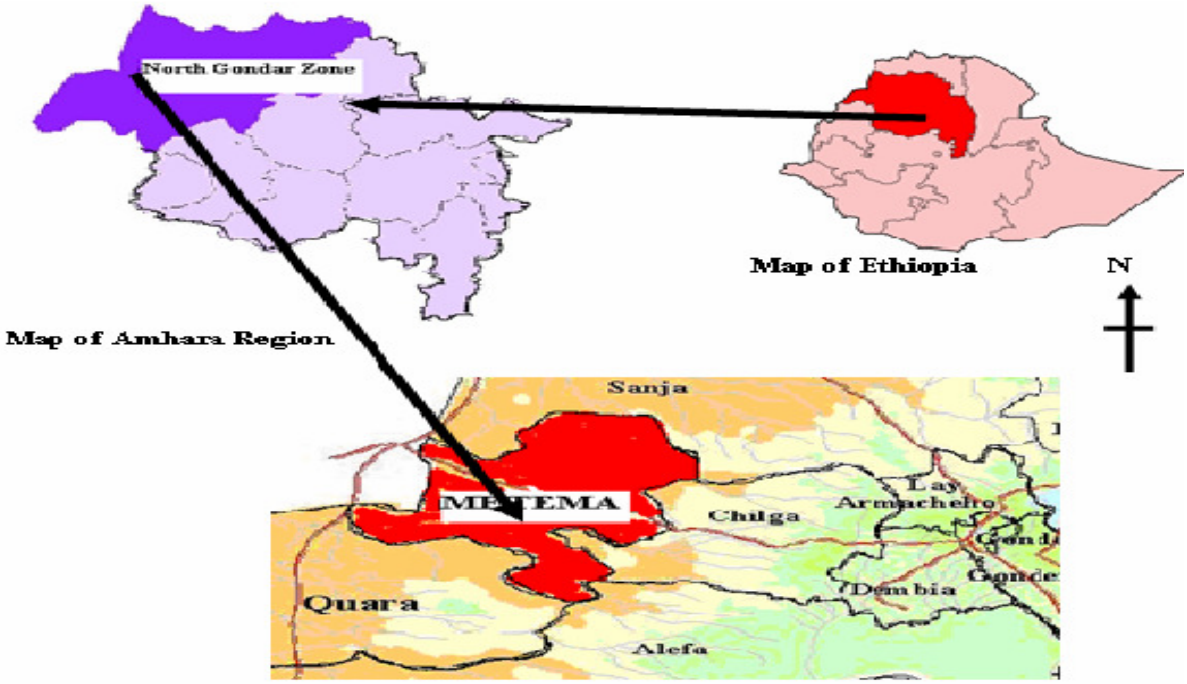

Figure 1. Map of the study area (Amhara region and Metema district)

Six treatments such as seeds treated with Apron Star 42 WS seed dressing chemical insecticides, seeds treated with Apron Star 42 WS seed dressing chemical insecticides plus application of Ethiosulfan 5 % dust insecticide, seeds treated with Apron Star 42 WS seed dressing chemical insecticides plus application of Diazinon 60% EC foliar insecticides, Ethiosulfan 5 % dust insecticide, Diazinon 60% EC foliar insecticides and Untreated check (control) were evaluated against termite. Detailed descriptions of the insecticides are indicated in "table 1". The seeds of the variety were divided into three groups. The first group was treated with Apron Star. The second and third groups of seeds were used for foliar and dust insecticides, Diazinon and Ethiosulfan, respectively. Seeds were treated 3 days earlier before sowing time by following the recommended rate, 250 gram of Apron Star 42 WS per 100 kilogram of seeds. The calculated rate of seed dressing insecticides and seed rate based on the plot size were mixed for 10 minutes and by applying small drop of water to facilitate adherence of the chemical with the seeds. Plastic bags were used as a container to mixing and treating seeds and the seed dressing chemical insecticide.

Application of Ethiosulfan 5% dust insecticide was applied by following the recommended rate, 8 kilogram per hectare. The intended rate of Ethiosulfan 5 % dust insecticide based on the plot size was applied into rows during sowing time. To ensure uniform application, Ethiosulfan 5% dust was mixed with sand in ratio of 1 part of dust to 4 parts of sand. Spraying of Diazinon 60% EC foliar insecticides was done by following the recommended rate, 1.5 liter per hectare. The calculated rate of Diazinon 60% EC foliar insecticide was sprayed 15days after seedling emerged for two times with 15 days intervals at evening time using knapsack sprayer. There was untreated check for comparison purposes. The treatments were arranged in Randomly Complete Block Design (RCBD) with three replications.

The plot size of 4mx4m was used for each treatment. Based on the agronomic package of the crop, 100 kilograms of seeds, 100 kilograms of DAP and 100 kilograms of urea per hectare was used to calculate the seed and fertilizer rates based on the plot size. NERICA-4 upland rice variety was used and sown on the plots at the space of 10 cm between plants and 20cm between rows (Table 1.)

Urea fertilizer was applied two times at sowing time and during tiller initiation stage of the crop in split form, whereas, DAP was applied the whole amount at sowing time. The spacing between replication and plots was 2 meters and 1.5 meters respectively. Agronomic practices were carried out as required.

Data Collected

Data was collected on number of damaged plants, stand count at harvest, height at harvest and yield (kg) per plot. The number of damaged plants by termites was recorded three times at 30, 60 and 90 days after Sowing (DAS) and counted by visual observation of plants that lodged and dried due to attack by termite. The counted damaged plants were discarded from the plot. Yield was recorded from the central rows and the rest two boarder rows were

Table 1. Detailed Descriptions of Insecticides

Trade name	Common Name	Active Compositions	Supplier Company
Apron Star 42 WS	Ethiothoate/Dimethoate	Thiamethoxam, Mefenoxam and Difenoconazole	Syngenta Agro-service AG,Basle/ Switzerland
Ethiosulfan 5% Dust	Ethiosulfan/Endosulfan	Alfa & Beta - Endosulfan(Techn)	Adamitulu Pesticide Company, Ethiopia
Diazinon 60% EC	Diazinon	Diazinon(Organophosphate,Cholinestrase inhibitor)	Adamitulu Pesticide Company, Ethiopia

not used to avoid boarder effects. Number of plants per plot and Plant height was recorded during harvesting.

Statistical Analysis

The analysis of variance for all treatments were carried out using SAS version 9.0(2008) statistical computer packages to examine the presence of statistically significant differences among treatments. Least Significant Differences (LSD) was employed to identify treatments that are significantly different to each other. The analysis of variance was made using model for randomized complete block design.

RESULTS

Field experiment

Evaluation of integrated use of seed dressing, dust and foliar chemical insecticide against termite was conducted at Gendewuha Research Station in Metema district under Gondar Agricultural Research Center since 2011/12 main cropping season. In this experiment three chemical insecticides were tested in sole and integrated form along with water spray treatment (control).The ravage of termite was very high at the first 30 days after the crop emerged and declined at the end of the vegetative stage of the crop. Due to early appearance of termite, two times spray were made to observe the efficacy of Diazinon foliar insecticide and one times application of this foliar insecticide for those plots sown with seeds treated with Apron Star seed dressing insecticide plus Diazinon treatment. Other treatments were applied during sowing time.

In the case of stand counting at harvesting, plots sown with seeds treated with Apron Star seed dressing insecticide plus Ethiosulfan dust insecticide (676.67) showed least significant differences compared with Plots sown with seeds treated with Apron Star seed dressing insecticide plus Diazinon foliar insecticide (646.67) and plots sown with only Apron Star seed dressing insecticide (595.00). Whereas, it showed high significant differences as sprayed with Diazinon foliar insecticide (515.00) and control (33167) as indicated in "table 2".

Least significant difference was observed between plots sown with seeds treated with Apron Star seed dressing insecticide plus Ethiosulfan dust insecticide (100.13cm), Plots sown with seeds treated with Apron Star seed dressing insecticide plus Diazinon foliar insecticide (95.40cm) and plots sown with only Apron Star seed dressing insecticide (87.13cm) on plant height recorded at harvesting. However, high significant differences were observed as compared to Ethiosulfan dust insecticide (81.86cm), plots sprayed with Diazinon foliar insecticide (77.20cm) and control (66.06cm), "table 2".

Plots sown with seeds treated with Apron star seed dressing insecticide plus Ethiosulfan dust insecticide showed no significant difference on damaged plants as compared to Plots sown with seeds treated with Apron Star seed dressing insecticide plus Diazinon foliar insecticide (646.67) and plots sown with only Apron Star seed dressing insecticide with least mean number of plants of 45, 60 and 71.67per plot respectively. However, significant number of damaged plants due to termite was recorded from plots treated with Ethiosulfan dust insecticide (98.33) and plots sprayed with Diazinon foliar insecticide (108.33). The highest number of damaged plants was recorded from control (226.67) as indicated in "table 2".

Regarding yield, there was significant difference between treatments. The highest yield was obtained from Plots sown with seeds treated with Apron Star seed dressing insecticide plus Ethiosulfan dust insecticide (6.20 kg) and Plots sown with seeds treated with Apron Star seed dressing insecticide plus Diazinon foliar insecticide (6.01kg) followed by plots sown with only Apron Star seed dressing insecticide (4.50kg) and plots treated with Ethiosulfan dust insecticide (3.00kg) The lower yield was obtained from plots sprayed with

Table 2. The Result of Insecticides on the Stand Count, Height of Plant, Number of Damaged Plants by Termite and Yield at Gendewuha Research Station in Metema District

Treatments	Stand counting at harvest	Plant height at harvest(cm)	Number of damaged plants per plot	Yield per plot(kg)
Apron Star 42 WS	595.00a	87.13b	71.67b	4.50a
Apron Star 42 WS plus Ethiosulfan 5% dust	676.67a	100.13a	45.00c	6.20a
Apron Star 42 WS plus Diazinon 60%EC	646.67a	95.40a	60.00c	6.01a
Diazinon 60%EC	515.00b	77.20b	108.33b	2.03b
Ethiosulfan 5% dust	533.33b	81.86b	98.33b	3.00b
Control	331.67c	66.06c	226.67a	1.08c
LSD	74.33	11.36	47.47	0.94
CV (%)	2.23	2.23	2.23	2.23

Diazinon foliar insecticide (2.03kg) and control (1.08kg) as indicated in "table 2".

Farmers' Perceptions about Upland Rice Production and Protection

The Informal survey about status of upland rice production and protection in Metema district was conducted before the field experiment since 2011 through interviewing key informants of the major rice producing areas of the woreda. Majority of farmers interviewed appreciated the efforts exerting by stakeholders especially Agricultural Research Centers and District Agricultural Offices on up-scaling of upland rice production through demonstration of improved varieties, seed multiplication and distribution via facilitate food security as well as improving income generating by societies. However, there are different obstacles hampering the above mentioned efforts. Among these, insect pests especially termite causes huge damage and yield loss on their rice crop production as well as no scientific based management efforts against termite except farmers using indigenous technical knowledge like applying of wood ash through scattering in the field; digging, picking and killing queen; making hole in the mound and dropping water; making way/furrow for water flow directed to the mound during land preparation; flooding the field and others are listed by interviewed farmers. However, they indicated that these traditional methods were not effective for all termite species as well as difficult to cover large hectare of lands. Therefore, most farmers suggested that in addition to these indigenous technical knowledge, scientifically based experiments should be conducted especially to keep their crops through effective managements as well as to save their time and labor forces. Generally, the majority of upland rice growing farmers in the district internalized the nature of the termite as well as effects on their crops.

CONCLUSION

Based on the overall results of the experiment, Apron Star seed dressing insecticide plus applying Ethiosulfan dust insecticide at sowing time or one times Diazinon foliar insecticide 15 days after seedling emerged have shown highest efficacy in controlling termite through reducing the population and damages via increasing yields. Sole application of Apron Star seed dressing insecticide has also showed promising results against termites followed by Ethiosulfan dust insecticide. Therefore, these integrated uses of seed dressing insecticide and dust or foliar insecticides can be safely

recommended as protection method against termite. The integrated uses should also be promoted for further evaluation with other management options as integral component for sustainable management of termite in upland rice growing areas of Metema district, especially integrating insecticides with indigenous technical knowledge of farmers to generate effective management options against termite.

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